Bigfork County Water & Sewer District

Public Water Supply – PWS ID # MT0000262

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Report Date: 25 March 2005

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FIGURES:

INTRODUCTION

This report is intended to meet the technical requirements for the completion of the Source Water Delineation and Assessment for the Bigfork County Water and Sewer Public Water Supply (PWS), # MT0000262. This report is completed as required by the Montana Source Water Protection Program and the federal Safe Drinking Water Act. Jeffrey Frank Herrick, a hydrogeologist with the Source Water Protection Program, Montana Department of Environmental Quality (DEQ) completed this Delineation and Assessment Report (SWDAR).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protecting public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is termed delineation and assessment. The emphasis of this delineation and assessment report is identifying significant potential contaminant threats to public drinking water sources and providing the information needed to develop source water protection planning.

Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported and then determining the potential for contamination of drinking water by these sources.

Delineation and assessment is the foundation of source water protection for the Bigfork area sources. Although voluntary, source water protection plans are the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the Bigfork area water operators and the community to be involved in source water protection planning and the possible development of a Source Water Protection Plan that is tailored to and meets their specific needs.

CHAPTER 1
BACKGROUND

The Community

The community of Bigfork is located in Flathead County, Montana at the intersection of Highways 35 and 209, and is situated on the northern east shore of Flathead Lake. The public water supply (PWS) addressed in this SWDAR is the Bigfork County Water & Sewer District PWS (MT0000262), which is classified as a Community PWS serving most of the residents of the community of Bigfork. It is listed as serving approximately 1,200 residents (~1,200 summer and ~900 winter residents) via 771 active service connections. The address and name of contact person for this PWS is listed on the cover of this document and in the next chapter. Bigfork is small town located along Highway 35 in south central Flathead County where the Swan River empties into Flathead Lake (see Figure 1 and Figure 2). According to the 2000 census, the population of Bigfork consists of approximately 1,421 people. Flathead County has a population of approximately 74,471 people and has grown around 25% since the 1990 census. The economy for the area of Bigfork is currently based mostly on tourism and recreation related service industries, but is supplemented by residential development and some timber harvesting. The town of Bigfork is serviced by a municipal sewer system, but any residents or businesses located outside of town must have their sewage discharged to onsite drain-fields. The density of these septic systems is discussed in Chapter 3 of this report. The northern extent of the Bigfork municipal sewer coverage isn't precisely known, but is not believed to be located upgradient of the production wells that supply water to the PWS. The Bigfork Co. W&S District production wells are located about 3 miles north of town.

Geographic setting

The town of Bigfork is located on the northeast shore of Flathead Lake and at the south end of what has been labeled as the Kalispell Valley. The Kalispell Valley and Flathead Lake are within a north-northwest trending intermontane basin in northwest Montana. The basin around Bigfork is bounded by Flathead Lake to the south and west, the Salish Mountains on the west, Stryker Ridge on the northwest, the Whitefish Range on the north, and the Swan Range on the east (Figure 1). Bigfork resides at an elevation of approximately 2,970 feet in town and 3,020 feet above mean sea level (MSL) near the PWS's production wells located north of town (Figure 2). The elevation of Flathead Lake hovers around 2,900 feet above MSL. The southwestward flowing Flathead River is the principal stream in the Kalispell Valley and it discharges into Flathead Lake about 2 miles west of town. The other significant river near Bigfork is the Swan River, which drains northward through the Swan Valley, then turns west and empties into Flathead Lake at Bigfork.

The climate in this area is a modified Pacific maritime climate that is typical of low elevation intermontane basins found in the Northern Rocky Mountains west of the Continental Divide. Generally, the area experiences a great deal of climatic influence from the lake, producing cooler summers, warmer winters, longer growing seasons, and more precipitation than areas further north or west of the lake. The nearest weather station is in the town of Bigfork. Historic climatic data for Bigfork is presented in Table 1 below. Bigfork has an average annual precipitation of approximately 22.06 inches and the total average snowfall is 56.2 inches. It appears that most of the rainfall occurs in spring and early summer each year.

Table 1. Climatic Data

Bigfork 13 South, Montana (240755)
Period of Record Monthly Climate Summary: Period of Record : 44/01/1938 to 12/31/2002

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	33.2	37.5	44.5	55.1	64.5	71.1	80.9	79.5	68.9	55.7	41.7	35.3	55.7
Average Min. Temperature (F)	21.7	23.8	27.4	34.2	41.2	47.7	52.7	52.0	44.7	37.2	29.4	24.7	36.4
Average Total Precipitation (in.)	1.80	1.24	1.34	1.62	2.69	3.13	1.53	1.52	1.81	1.60	1.85	1.93	22.06
Average Total Snowfall (in.)	17.7	9.5	5.8	0.8	0.2	0.0	0.0	0.0	0.0	0.4	6.9	14.9	56.2
Average Snow Depth (in.)	5	5	3	0	0	0	0	0	0	0	1	4	1

Note: Western Regional Climate Center, wrcc@dri.edu

General description of the Source Water

The primary aquifers in the southern Kalispell Valley (around Bigfork) are found within the following groups of materials: metasedimentary rocks of the Middle Proterozoic Belt Supergroup, which surround the area; Tertiary sediments that underlie most of the basin (beneath the younger Quaternary sediments); and Quaternary alluvium and glacial outwash or till deposits that fill the valley. Figure 3A and Figure 3B are geologic maps and depict the distribution of surficial geologic deposits around Bigfork. The Bigfork Water & Sewer District operates 2 wells that are drilled and installed into a confined aquifer that is laterally continuous across most of the Kalispell Valley. The thickness of the shallow alluvium (which contains one or more unconfined aquifers) is depicted on Figure 3C. Some domestic wells in the area draw from the shallowest water table with total depths between 16-58 feet bgs, but these wells are few in number due to the seasonal fluctuations of the shallow water table. The thickness of the aquitard (the confining layer(s)) above the confined aquifer is depicted on Figure 3D. There are few wells that tap into water bearing zones within this generally unproductive unit, but any water-bearing sand and/or gravel stringers that may be present are generally limited in storage and lateral extent. Most wells in the area tap into the confined aquifer and range in depths between 192-333 feet bgs. This aquifer produces the best quality and most dependable water in the area. Only and handful of wells draw from sediments deeper than 350 feet. A map of the potentiometric water elevations within the confined aquifer is found on Figure 3E. An examination of these potentiometric elevations for the confined aquifer suggest that groundwater flow in the area north of Bigfork and in the vicinity of the Bigfork Water & Sewer District PWS wells is toward the northwest and west where it probably discharges into the Flathead River. Figure 3B, Figure 3C, Figure 3D and Figure 3E are taken from the Montana Bureau of Mines and Geology MBMG) Montana Ground-Water Assessment for the Flathead Area (May 2001). A summary of some well construction and lithologic logs for wells in the area is contained in Appendix C of this SWDAR. The static water level for the Bigfork W&S production wells is approximately 70-77 feet below ground surface (bgs), with the total well depths at 295 and 310 feet bgs. Lithologic and construction logs for these and other wells are present in Appendix B.

The Bigfork Co. W&S District PWS (ID# MT0000262) is classified by DEQ as a Community PWS. Its source wells are identified as Well #1 1992 Ramsfield East (source # WL003) installed on 26 March 1992 and Well #2 1993 Ramsfield West (WL004) installed on 15 July 1993. The wells appear to have been completed in the deep confined aquifer beneath the area that is probably composed of alluvium and glacial out-wash deposits. The general groundwater flow direction beneath the Bigfork Co. W&S District wells is probably northwest to west and toward the Flathead River. It should be noted that there are 2 other wells listed in the DEQ PWS database (Well #1 Eagle Bend WL005 and Well #2 Eagle Bend WL006), and an old infiltration gallery (Infiltration Gallery IN002), but both of these wells and the infiltration gallery are currently listed as Inactive. According to the Sanitary Survey (05/30/2001) that was completed for the Bigfork Water and Sewer District PWS by the Department of Environmental Quality, Public Water Supply Section, the PWS has 771 active service connections that serve approximately 1,200 people (all residents). Although there is probably a large transient (tourist) population for the area, this was not estimated. The 2 source wells are connected to a 350,000-gallon concrete storage tank and a 250,000-gallon steel storage tank that provide pressure to the distribution system and connections in town. Although there is a water treatment plant located between the 2 production wells and prior to distribution or storage, the source water is not currently treated. The following is a tabular summary of the Bigfork Water and Sewer District PWS as listed in the DEQ PWS Section database.

Table 2. PWS Facilities and Well Information
Bigfork PWS (MT0000262)

Operator / Contact Person & Address	**Leland Leivo** **Bigfork Water and Sewer District** **Town of Bigfork** **PO Box 1108** **Bigfork, MT 59911 Phone: 406/837-4566**				
Class	Community Non-Transient				
Well/Intake Source Code	**WL003**	**WL004**	WL005 / EP504	WL006 / EP505	IN002 deleted
Well/Intake Name	**Well 1 1992 Ramsfield East**	**Well 2 1993 Ramsfield West**	Well 1 Eagle Bend	Well 2 Eagle Bend	Infiltration Gallery (called surface water)
Status	**Active**	**Active**	Inactive	Inactive	Inactive
Location (Lat. & Long.)	48.1125 -114.0997	48.1122 -114.1007	48.0738 -114.1044	48.0679 -114.0996	*

Table 2. PWS Facilities and Well Information **Bigfork PWS (MT0000262)**			
Common header for Wells 1 & 2 Ramsfield	**CH001** **/ EP503 Active**		
Treatment Plants	**TP for Wells 1 &2 Ramsfield** Located between the wellheads, **Treatment plan is not currently being used to treat the water**	*****	TP for Infiltration Gallery (surface water) Location not known Inactive
Treatment Plant ID	**TP003** **Not in use**	*****	TP002 Inactive
Distribution System	**DS001** **/ SP001** **Active**		
Storage Tanks	**Storage Facility 1, Concrete** **350,000 gallons**	**Storage Facility 2, Steel** **250,000 gallons**	Storage Tank at Eagle Bend Deleted
Storage Description	**ST001** **Active**	**ST002** **Active**	ST003 Inactive
Storage Location (Lat. & Long.)	48.0702 -114.08553	48.06703 -114.07856	*****

*****No precise information was available at the time this report was written.

Water Quality

The Bigfork PWS wells have been sampled as part of regular water quality monitoring for public water supplies. The bacteriological and inorganic analytical data for this sampling is displayed on tables within Appendix A of this report. These data tables are presented along with output from the DEQ PWS Section database and relevant correspondence found in DEQ files. Standards compliance with regulated contaminants occurs on a variety of sampling schedules.

Coliform bacteria have shown up in several routine samples collected in the past few years, but the resampling did not confirm their presence in the water supply. According to the DEQ water quality history database there are periodic and recurring very low concentrations of nitrate in the PWS, but there were no exceedences for any of the regulated contaminants in the last five years. The very low levels of nitrate are not believed to be a concern. It appears that this PWS has a Waiver from sampling and analysis for SOCs.

Sewage for businesses and residences in Bigfork is discharged to the community wastewater treatment plant for treatment before that plant discharges to Flathead Lake. Localized areas where there is an increased concentration (increased density) of sewage drain fields are present around or directly upgradient from all of the wells described in this report and some of these systems are thought to be large capacity septic systems. Most of the PWSs in the area have routinely low nitrates present in their systems, but the deeper the wells and more isolated they are from human sources of nitrates, the safer those wells will be in the future form this type of contamination. Some background water quality data has been assembled and is found in Appendix C of this document.

CHAPTER 2
DELINEATION

Delineation Process

The source water protection regions, the delineated land areas that contribute water to wells in Bigfork are identified in this chapter. Three management or source water protection regions are usually identified. These three regions are the Control Zone, Inventory Region, and Recharge Region. The Control Zone, also known as the exclusion zone, is an area at least 100-foot radius around the wellhead, spring collection box, or surface water intake. Human activity in this area can have an immediate impact on water quality, by introducing contaminants into the area directly above a well screen or other intake. As such, management of this Control Zone is critical to protect a PWS. The Inventory Region usually represents the zone of contribution of the well, which can approximate a three-year groundwater time-of-travel or a 1-mile radius around a wellhead. The Inventory Region comprising a 1-mile radius circle around a well is often a conservative value that is used either for convenience or when insufficient geologic or hydrogeologic information is available about an area or details are lacking on the construction of a production well. In certain circumstances where a PWS well taps into an aquifer that has been characterized as being confined, the Inventory Region can be limited to a 1,000 foot radius around the well head, and the inventory of potential contaminant sources is only completed for those sources within 1,000 feet of the well. Activities or contaminant releases in the Inventory Region have the potential to reach a PWS well in a period approximating less than 3 years. The Recharge Region represents the entire portion of the aquifer or an area that contributes water to the local aquifer and over time supplies water to a well. This extended region of groundwater recharge is often, but not always inclusive of the limits of a watershed. At times an entire watershed is too large to be realistically manageable by a PWS or community, so a subsection of that watershed is delineated as the Recharge Region. Long-term water quality at a PWS can be affected by contaminant releases or certain land use activities in the Recharge Region. Table 3 summarizes how these source water protection regions are determined.

Table 3. Methods and Criteria for Delineating Source Water Protection Regions

If Your Source of Water Is	Delineate These Water Protection Regions	Method For Each Region	Minimum Distance Values & Type of Inventory Required
1. **Ground Water that is**:			
• **Unconfined or Semi-confined***	Control Zone Inventory Region Recharge Region	Fixed radius Fixed radius Topography	Distance - 100 feet Distance - 1 mile Limits of the watershed
• **Confined**	Control Zone Inventory Region Recharge Region	Fixed radius Fixed radius Topography	Distance - 100 feet Distance - 1000 feet Limits of the watershed
*Ground Water that is hydraulically Connected to Surface Water also needs the following ---------->>	Surface Water Buffer Zone	Fixed Distance	In addition to the Inventory Region, a one-half mile surface water buffer will extend upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. The buffer will not exceed the extent of the watershed. Inventory is limited to pathogens and nitrate sources.
Surface water	Spill Response Region Watershed Region	Fixed Distance Topography	One-half mile buffer extending upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. Buffer will not exceed the extent of the watershed. Limits of the watershed

Hydrogeologic Conditions

The primary aquifer(s) from which Bigfork Water and Sewer District PWS wells draw water is in the active basin of the Flathead River near where it empties into Flathead Lake. A great deal of the following discussion is taken directly from the excellent hydrogeologic descriptions found in the USGS Hydrologic Summaries of Intermontane Basins Report 96-4025 (1996). The aquifers present in the area are described as Holocene floodplain aquifers, Pleistocene perched aquifers, Pleistocene confined aquifers, and the Precambrian bedrock aquifer. The Holocene floodplain aquifers include the deltaic-sand aquifer south of Kalispell and the alluvial-gravel aquifer underlying the floodplains of the Flathead and Whitefish Rivers north of Kalispell. The Holocene deltaic-sand aquifer south of Kalispell is not an important source of water because it is much less permeable and has more dissolved constituents than the underlying confined aquifer. Stage fluctuations of ten feet in Flathead Lake (due to releases from Kerr Dam) annually reverse the hydraulic gradient in the deltaic-sand aquifer within 0.5 miles of affected surface water bodies, including Flathead Lake, the Flathead River, and the associated oxbows and sloughs of the river valley. Precipitation and evapotranspiration also directly affect storage in this aquifer. There are a couple of types of Pleistocene perched aquifers in the area that are separated from the underlying confined aquifers by clay, till, or cemented gravel. These are usually laterally discontinuous, low permeability, dune and lacustrine (lake) sand aquifers on the tops of some terraces and a glacial drift aquifer in the pothole lake area in the eastern part of the basin (north and east of Bigfork). The glacial drift aquifer is not used much despite its favorable hydraulic properties because it is located in an area with plentiful surface water bodies. Two Pleistocene confined aquifers are present in the area and are separated from overlying units by 10 to 400 feet of till and/or silt. Both are composed of sand and gravel. The shallower of the 2 aquifers is present locally near Creston and is not laterally extensive. The other confined aquifer is relatively deep and is laterally extensive. This aquifer consists of glacial outwash and underlies the entire basin (the Kalispell Valley). It is the principal aquifer for the entire region and supplies municipal water for the communities of Kalispell, Columbia Falls, and Bigfork. This aquifer is also extensively used for irrigation for many hundreds of acres of agricultural land as well as being taped into be a majority of the domestic wells in the area. Within the deep Pleistocene confined aquifer, groundwater generally flows from the edges of the basin toward the Flathead and Whitefish Rivers and toward Flathead Lake. This aquifer is recharged by precipitation and runoff near the basin margins and by subsurface flow form the surrounding mountains. The deep confined aquifer is made up of Pleistocene glacial outwash and other fluvial materials, and with depth grades into older Tertiary gravels and sands. The depth and thickness of these older units has never been fully characterized. The Precambrian bedrock aquifer is an important source of water near the outcrops and other areas where overlying basin fill is either thin or not productive. This aquifer can be confined where is lies beneath finer grained glacial materials or behave as if it were confined if the producing fractures into which a well is drilled lies sufficiently deep. In shallower conditions, the bedrock aquifer is clearly behaving as an unconfined aquifer.

The primary aquifers in the southern Kalispell Valley (around Bigfork) are found within the metasedimentary rocks of the Middle Proterozoic Belt Supergroup (the bedrock) which underlies and surrounds the area; Tertiary sediments that underlie most of the basin (deep beneath the younger Quaternary sediments); and Quaternary alluvium and glacial outwash or till deposits that fill the valley. Figure 3A and Figure 3B are geologic maps and depict the distribution of surficial geologic deposits around Bigfork. The Bigfork Water & Sewer District operates 2 wells that are drilled and installed into a confined aquifer that is laterally continuous across most of the Kalispell Valley. The thickness of the shallow alluvium (which contains at least one shallow and unconfined aquifer) is depicted on Figure 3C. Some domestic wells in the area draw from the shallowest water table with total depths between 16-58 feet bgs, but these wells are few in number due to the seasonal fluctuations of the shallow water table. The thickness of the aquitard (the confining layer(s)) above the deep confined aquifer around Bigfork is depicted on Figure 3D. There are few wells that tap into water bearing zones within this generally unproductive unit, but any water-bearing sand and/or gravel stringers that may be present are generally limited in storage and lateral extent. Most wells in the area tap into the confined aquifer and range in depths between 192-333 feet bgs. This aquifer produces the best quality and most dependable water in the area. This deep confined aquifer beneath the Bigfork production wells is probably recharged northeast and east of the wells and mostly along the range front of the Swan Range. It is not clear how far that recharge area extends into the Kalispell Valley. Only and handful of wells draw from sediments deeper than 350 feet, which may be drawing from older Tertiary sediments. A map of the potentiometric water elevations within the confined aquifer is found on Figure 3E. An examination of these potentiometric elevations for the confined aquifer suggest that groundwater flow in the area north of Bigfork and in the vicinity of the Bigfork Water & Sewer District PWS wells is toward the northwest and west where it probably discharges into the Flathead River. Figure 3B, Figure 3C, Figure 3D and Figure 3E are taken from the Montana Bureau of Mines and Geology MBMG) Montana Ground-Water Assessment for the Flathead Area (May 2001). A summary of some well construction and lithologic logs for wells in the area is contained in Appendix C

of this SWDAR. The static water level for the Bigfork W&S production wells is approximately 70-77 feet below ground surface (bgs), with the total well depths at 295 and 310 feet bgs. Lithologic and construction logs for these and other wells are present in Appendix B. This deep aquifer is characterized as having low source water sensitivity to contamination. This is based on criteria used by the DEQ Source Water Protection Program as outlined on Table 4.

Table 4. Source Water (Aquifer) Sensitivity

High Source Water Sensitivity	Moderate Source Water Sensitivity	Low Source Water Sensitivity
• Surface water and GWUDISW • Unconsolidated Alluvium (unconfined) • Fluvial-Glacial Gravel • Terrace and Pediment Gravel • Shallow Fractured or Carbonate Bedrock	• Semi-consolidated Valley Fill sediments (semi-confined) • Unconsolidated Alluvium (semi-confined)	• Consolidated Sandstone Bedrock • Deep Fractured or Carbonate Bedrock • Semi-consolidated • **Confined Aquifers**

PWS Wells Information

What is known about the sources used by the Bigfork County Water & Sewer District PWS is summarized in Table 5 below.

Table 5. PWS Source Information
Bigfork W&S District PWS (MT0000262)

Source Name	**Well 1 1992 Ramsfield East**	**Well 2 1993 Ramsfield West**	Well 1 Eagle Bend	Well 2 Eagle Bend	Infiltration Gallery (called a surface water source)
Source Code	**WL003**	**WL004**	WL005	WL006	IN002
Status	**Active**	**Active**	Inactive	Inactive	Inactive / Deleted
Location (Lat. & Long.)	48.1125 -114.0997	48.0738 -114.0707	48.0735 -114.1044	48.0679 -114.0996	*
MBMG GWIC #	132061	132453	*	*	*
Water Right #	P080206-00	P080206	*	*	*
Date completed	**26 March 1992**	**15 July 1993**	*	*	*
Total Depth (feet bgs)	**295**	**310**	~30	~30	*
Perforated Interval (ft bgs)	**245-258** **264-271** **275-280**	**245-260** **280-271**	*	*	*
Static Water Level (ft bgs)	**69.7**	**77**	*	*	*
Pumping Water Level (ft bgs)	*	**150**	*	*	*
Draw Down (ft)	*	**73**	*	*	*
Test Pumping Rate (gpm)	**414**	**540**	*	*	*
Yield (gpm)	**954**	**613**	*	*	*

* This indicates that no information was available at the time this report was written.

Delineation Results

The delineations for the source water protection regions as done by assuming the PWS wells 1 & 2 (Ramsfield East and West) are withdrawing water from a thoroughly characterized confined aquifer. The Control Zone is delineated to provide a minimum 100-foot radius buffer around each of the wellheads. The Inventory Region was delineated as a 1,000-foot radius circle around each of the 2 active wells and it is depicted on Figure 5. The former wells and the infiltration gallery are not active and were not included in this delineation. If these sources of water were included, the Inventory Region would encompass an area on either side and at least 10 miles up the Swan River and several miles north and east of Bigfork. But

since the current PWS does not draw water from these shallow wells and from the alluvium of the Swan River, the Inventory Region is limited to the area immediately around the deep aquifer wellheads located north of town. The Inventory Region is small for these 2 wells because the most significant factor in the potential for contamination to reach the well intakes is not the proximity or size of potential contaminant sources alone, but it is the presence of nearby poorly constructed wells (or the PWS wells themselves) that are not well sealed across the confining unit(s). The presence of these wells within the Inventory Region determines the significance of any potential contaminant sources because these wells might be the avenues of contaminant migration from the near surface into the confined aquifer. The Recharge Region is as depicted on Figure 6. It extends from just north of Bigfork, east to the ridgeline of the Swan Range, west to the Flathead River, and north to Columbia Heights. It is the belief of this author that the area of greatest recharge to the deep aquifer in this part of the Kalispell Valley is probably right along the range front of the Swan Range and may include some of the area just east of Highway 206 and northeast of Highway 35. Potential contaminant sources are present in Recharge Region that are of note, but these will be discussed in the next chapter.

Limiting Factors

Groundwater behavior in general terms is reasonably well understood in the Kalispell Valley, but is not easily predictable beneath specific locations and especially around a certain well that is drawing water from a specific depth. Groundwater flow direction fluctuates seasonally and from year to year. This author has made several conservative assumptions in the delineation of the source water protection areas and the development of this report. The author used his professional judgment and reliance on some basic hydrogeologic principals to define the aquifer boundaries and groundwater movement. However the Report can and should be revised if more data becomes available that alters the assumed groundwater flow direction(s).

CHAPTER 3
INVENTORY

Inventory Method

An inventory of potential sources of contamination was conducted for Bigfork County Water & Sewer District PWS within the Control Zone, Inventory Region, and Recharge Region. Potential sources of all primary drinking water contaminants and Cryptosporidium were also identified and noted, however, only significant potential contaminant sources were selected for detailed inventory and the susceptibility evaluation that occurs in Chapter 4 of this SWDAR. It should be noted that the inventory emphasizes potential contaminant sources. Inclusion of a facility or business in the inventory does not indicate that it is an actual polluter. The exception to this would be known hazardous waste sites where past releases have occurred, locations with leaking underground storage tanks (LUSTs), or wastewater dischargers.

The inventory for Bigfork Co. W&S Distr. PWS (specifically the area around the 2 deep wells) focuses on all activities in the Control Zones for the wells, certain types of municipal and private facilities in the Inventory Region, and general land uses and large facilities in the Recharge Region. The following databases have been searched in an effort to identify generators, storage facilities and land uses that could be potential generators of contamination in the Inventory Region.

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's Geographic Information Retrieval and Analysis System (http://nris.state.mt.us/gis/datalist.html). Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities.

Step 2: As appropriate, EPA's Envirofacts System (http://www.epa.gov/enviro/) was queried to identify EPA regulated facilities located in the Inventory Region. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility should be classified as a significant potential contaminant source.

Step 3: The Permit Compliance System (PCS) was queried using Envirofacts (http://www.epa.gov/enviro/) to identify Concentrated Animal Feeding Operations with MPDES permits. The PWS system operator and/or system owners are familiar with the area included in the Inventory Region will have identified animal feeding operations that are not required to obtain a permit.

Step 4: Databases were queried to identify the following in the Inventory Region: Underground Storage Tanks (UST) (http://webdev.deq.state.mt.us/UST/), hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau), landfills (http://nris.state.mt.us/gis/datalist.html), abandoned mines (http://nris.state.mt.us/gis/datalist.html) and active mines including gravel pits. Any information on past releases and present compliance status was noted.

Step 5: A business phone directory was queried to identify businesses that generate, use, or store chemicals in the Inventory Region. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code.

Step 6: Major road and rail transportation routes were identified throughout the Inventory Region (http://nris.state.mt.us/gis/datalist.html).

Step 7. All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the Recharge Region and identified on the base map.

Potential contaminant sources are designated as significant if they fall into one of the following categories:

1. Large quantity hazardous waste generators.
2. Landfills.
3. Underground storage tanks.
4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal

superfund sites, and UST leak sites).
5. Underground injection wells.
6. Major roads or rail transportation routes.
7. Cultivated cropland greater than 20 % of the Inventory Region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Septic systems.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines.

Inventory Results/Control Zone

None of the documents examined for this SWDAR noted the presence of any activities or potential contaminant sources within 100 feet of the 2 deep production wells. The compound containing the 2 wells and the water treatment plant is fenced and access is controlled. The water treatment plant/control building is located directly between the 2 deep wells and at least 90-95 from the wells. Diagrams for the structure or grounds do not indicate a restroom or septic system, so the assumption is that there are none. As such, no contaminant sources or activities are known to be present in the Control Zones for the 2 wells. The Control Zones for the 2 wells do extend beyond the outside fence of the compound. No activities on the far side of the fence are known to occur, but this is a subject that should be closely monitored by the system operator(s).

Inventory Results/Inventory Region

The area surrounding the Inventory Region for the Bigfork Co. W&S District PWS wells is all un-sewered with private onsite septic tanks and drain fields. Septic density (the density of private septic systems) within and around the Inventory Region is low. No community septic systems or wastewater treatment systems are present in the vicinity or directly upgradient (east) of the Inventory Region. But there are areas of increased density of septic systems to the east and southeast (which is probably upgradient) from the PWS wells. Any businesses, offices, or other public facilities in the area can probably be considered to have large capacity septic systems. The US Forest Service appears to have an office near the boundary of the Inventory Region along the southeast side. Large capacity septic systems are those that service at least 20 people per day for more than 6 months of the year. These systems are not documented, so it is difficult for the author to determine their actual locations. Land use in the Inventory Region around The Bigfork Co. W&S District PWS wells is approximately: 62% pasture and hay and 28% evergreen forest, with small grains accounting for about 7 % of the area. Grassland and shrubland account for the remainder (see Table 6 and Figure 7). None of these land uses would typically pose a threat to this PWS. Other than the single large capacity septic system, there are no other significant potential contaminant sources included the Inventory Region (listed on Table 7). Figure 5 depicts the Inventory Region and the nearby potential contaminant sources.

Table 6. Land Use

Bigfork Co. W&S District PWS
Refer to Figure 7

Inventory Region	**Land Use**					
	Pasture / Hay	Evergreen Forest	Small Grains	Grassland / Herbaceous	Shrubland	
	61.8%	27.9%	7.2%	2.4%	0.8%	
Recharge Region	**Land Use**					
	Evergreen Forest	Small Grains	Pasture / Hay	Grassland / Herbaceous	Shrubland	Open Water
	33.5%	25.8%	17.0%	10.5%	4.2%	3.1%

Inventory Results/Recharge Region

The Recharge Region as delineated for this SWDAR is composed of the following land uses: approximately 73% evergreen forest, 8% open water, 8% shrubland, 5% grassland, 3% bare ground, and 0.7% deciduous forest. Land use in the Recharge Region is depicted on Figure 7. None of these land uses appear to be significant potential contaminant sources for this PWS. Septic density in the Recharge Region as a whole is low, as noted within the Inventory Region. But there are areas of

increased septic density and numerous large capacity septic systems located upgradient of the PWS wells, mostly scattered along the Highway 35 and 206 corridors that run north and south through the length of the Recharge Region. This transportation corridor itself is a significant potential contaminant source because of the size and magnitude of chemical releases that could occur from any one vehicular accident (e.g., a tanker truck rollover). Additionally, Highway 35 runs adjacent to and just east of the boundary for the Inventory Region. The Recharge Region also contains a number of underground storage tanks or leaking underground storage tanks (USTs/LUSTs), a couple of gravel pits, at least a couple of MDT maintenance facilities, and a single regulated stormwater discharger. Some of these potential contaminant sources are plotted on Figure 6. Table 7 below is a listing of potential contaminant sources in the Inventory and Recharge Regions. An evaluation of the hazard of the more significant potential contaminant sources and the determination of the PWS's susceptibility to them is discussed in the next chapter.

Table 7. Noteworthy potential contaminant sources

Bigfork Co. W&S District PWS – Inventory Region & Recharge Region

Source	Contaminants	Description
Cropped Agricultural Land within the IR	SOCs, Nitrates	Over application and spills of pesticides or fertilizers
USTs/LUSTs in the RR	VOCs, petroleum hydrocarbons	Accidental spills or releases of petroleum to groundwater
Septic Systems (general density of systems) in the IR and RR	Pathogens, Nitrates, other organic and inorganic chemicals	Waste water discharged to drain fields that may contain improperly disposed chemicals or may not completely eliminate nitrate and pathogens from the effluent
Septic Systems (localized higher density of systems) in the RR	Pathogens, Nitrates, other organic and inorganic chemicals	Waste water discharged to drain fields that may contain improperly disposed chemicals or may not completely eliminate nitrate and pathogens from the effluent
Large Capacity Septic Systems (for businesses, offices, & shops) within/near IR and in the RR	Pathogens, Nitrates, other organic and inorganic chemicals	Waste water discharged to drain fields that may contain improperly disposed chemicals or may not completely eliminate nitrate and pathogens from the effluent
Highways 35 and 206, and other local roads in the RR	Hazardous Materials (VOCs, SOCs, metals, other)	Large scale spills of hazardous or other materials
MDT Maintenance Facilities in the RR	Pathogens, Nitrates, other organic and inorganic chemicals	Wastewater discharged to drain fields or leaking from storage tank that may contain improperly disposed chemicals or normal human waste effluent. If an onsite septic tank and drain field is present, it may not completely eliminate nitrate and pathogens from the effluent. Large stockpiles of materials may allow migration of contaminants off the property or into groundwater.

Note:

- This table lists noteworthy potential contaminant sources. Those potential sources considered significant will be included in the susceptibility assessment that is performed in the next chapter of this SWDAR.
- IR is the Inventory Region, RR is the Recharge Region
- A single large capacity septic system appears to be present within the IR. This is identified at the same location as the USFS well, on the southeast boundary of the IR (see Figure 5). If this is not a USFS office or other facility, this is not a large capacity septic system and is not considered a contaminant source within the IR.
- No municipal or community sewer system is present in the IR, and probably not in the RR.
- USTs are documented underground storage tanks
- LUSTs are documented leaking underground storage tanks
- Gravel pits show up during the inventory process, but of themselves are not sources of contamination. If contaminant releases occur in the pit or if materials are disposed in the pits, these pits can act as underground injection wells and can facilitate contaminant migration into the unconfined aquifer.

Inventory Update

To make this SWDAR a useful document in the years to come, the owners, manager, or the certified water system operator(s) for the Bigfork Co. W&S District public water supply should update the inventory for their records every year. Changes in land uses or the presence of new potential contaminant sources should be noted and additions made as needed. This updated inventory should be submitted to DEQ at least every 5 years to ensure that this report/plan stays current in the public record.

Inventory Limitations

The extent of the potential contaminant source inventory is limited in several respects. The inventory is based on data that is readily available through state documents, published maps and reports, GIS data, and discussions with people that are familiar with the area. Also, documentation may not be readily available on some potential sources. An example of this is the large capacity septic systems that are present near the Inventory Region and in the Recharge Region. As a result, all potential contaminant sources may not have been identified or recognized as being significant potential contaminant sources. The author of this SWDAR is depending on local PWS owners and/or operators for site-specific knowledge. Their initial review of this document has been sought and their comments were incorporated.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

General Discussion

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case Bigfork Co. W&S District PWS owners and operators. The goal of Source Water Management is to protect the source water by 1) controlling activities in the Control Zone, 2) managing significant potential contaminant sources in the Inventory Region, and 3) ensuring that major land use activities or other significant activities in the Recharge Region pose minimal threat to the source water. Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by the PWS owners and operators to reduce susceptibility are recommended in this chapter.

Hazard Determination

The Susceptibility of Bigfork Co. W&S Distr. PWS production wells to various types of contamination is assessed in the following paragraphs. The proximity of a potential contaminant source to a spring or well intake, potential contaminant migration pathways, or the density of potential non-point contaminant sources determines the threat of contamination, referred to here as hazard (Table 8). Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 9. Table 8 below describes the criteria to determine hazard within the Inventory Region as it was delineated in this SWDAR. Note that this table is specific to PWSs that draw their water from confined aquifers. The determination of hazard is somewhat different for other types of water sources. For the situation involving the Bigfork Co. W&S District, it's 2 deep production wells are grouted to about 40-50 feet (below ground surface) with casing extending below that. But the finer sedimentary materials that represent the confining unit of the extensive deep confined aquifer from which the wells draw water begin to show up between 150-160 feet bgs. Although the wells appear to be constructed properly, they are not considered adequately sealed into or across the confining unit. Thus they are considered to be possible conduits for the migration of contaminants between the shallow unconfined alluvial aquifer(s) and the deep aquifer. As such, any point source in the Inventory Region is considered to have a high hazard. Refer to Table 8 below.

Table 8. Hazard of potential contaminant sources

For wells drawing water from confined aquifers

Potential Contaminate Sources within the Inventory Region	The PWS well is not sealed through the confining layer	Other wells in the inventory region are not sealed through the confining layer	All wells in the inventory region are sealed through the confining layer
Point Sources	High	Moderate	Low
Septic System Density (# per square mile)	High: > 300 Moderate: 50 to 300 Low: < 50	Moderate: > 300 Low: < 300	Low
Municipal or Community Sanitary Sewer (% land use)	High: > 50 Moderate: 20 to 50 Low: < 20	Moderate: > 50 Low: < 50	Low
Cropland (% land use)	High: > 50 Moderate: 20 to 50 Low: < 20	Moderate: > 50 Low: < 50	Low

Notes:

- Highlighted areas are those relevant to the Bigfork Co. W&S Distr. Inventory Region.
- There is no municipal or community sewer system present within or near the Inventory Region described in this SWDAR.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the Bigfork Co. W&S District well intakes. First, hazard is rated by the proximity of a potential contaminant source to the well(s) and the quality of sealing through a confining

unit above the well intake. Susceptibility ratings are then determined individually for each significant potential contaminant source and/or contaminant based on Table 8. These susceptibility ratings are the evaluation of the vulnerability of wells to the potential contaminant sources and are presented on Table 9.

Table 9. Susceptibility, based on Hazard and Barriers.

Presence Of Barriers	Hazard		
	High	**Moderate**	**Low**
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

Discussion of Susceptibility

A summary of the susceptibility assessment for Bigfork W&S PWS wells is located in Table 10. Below is a brief discussion of the susceptibility assessment for the significant potential contaminant sources. Because a contaminant source has not been identified in the inventory or susceptibility assessment of this report, it doesn't mean that the potential for contamination does not exist or is not a threat. So, if potential contaminant sources are present near or upgradient of any PWS, it would be prudent to understand the threat from these sources.

Sewer Drain Fields

Septic tank effluent is the greatest potential contaminant source to this PWS. There are no known municipal or community sewer systems within the Inventory Region and probably none within the Recharge Region. As such, these are probably of no concern. The density of septic systems within the Inventory Region is low (few small domestic septic systems are thought to be present). There are a couple of barriers thought to be in place, which are the thickness of the shallow water table aquifer beneath the site and the very low number of these septic systems (probably 2 or 3 total). This potential contaminant source (a non-point source) is considered to pose a low hazard with the susceptibility of the PWS wells to this contaminant considered to be very low. There are areas of localized higher septic density (medium density) and numerous large capacity septic systems present in locations that are probably upgradient to the PWS wells. Susceptibility to these point sources is determined only if these sources are in close proximity and/or within the Inventory Region. The areas of localized higher septic density are remote from the Inventory Region, so they are not evaluated. A single large capacity septic system associated with the USFS office may be within or near the boundary of the Inventory Region. Therefore the hazard is ranked as very high for this single potential contaminant point source. A single barrier is believed to be present, which makes the PWS wells have a high susceptibility to that contaminant source. Although the Bigfork Co. W&S District PWS wells are considered to have a high susceptibility to the single USFS large capacity septic system, the actual threat from this system may or may not be that great. It's precise location and distance from the PWS wells is not known, and the number of people that use the system has not been established. With greater distance and fewer persons using the system, the hazard and susceptibility drop dramatically. There are questions at the time of the writing of this SWDAR if there is indeed a USFS office or other facility at the location plotted on Figure 5. If there is not USFS office or other facility within the Inventory Region, there is not hazard from that potential contaminant source. Businesses or other larger facilities in the area probably operate large capacity septic systems. These businesses or other types of facilities are located outside of the Inventory Region and are thus not included in the determination of susceptibility. If industrial or residential development occurs in upgradient locations, especially in areas that are closer to the mountain range front (the area that recharges the lower aquifer and supplies this PWS with water), this is a subject of concern may directly affect future water quality. It is noteworthy that the Bigfork Co. W&S District PWS production wells do have a history of low levels of nitrates present samples. This nitrate may come from natural sources (wildlife). But the consistently low concentrations over an extended period may be reflective of some human source in a remote upgradient location within the recharge area of the aquifer. Suggested management to reduce the impacts from septic waste in the shallow and deep aquifers of the region includes the aggressive promotion of advanced septic treatment systems, the promotion of upgrading and maintenance of antiquated private septic systems, and the potential development of local community sewer and wastewater treatment systems for larger residential or industrial developments.

Table 10. Susceptibility Assessment

Bigfork Co. W&S Distr. PWS – Inventory Region (only)

Source	Contaminants	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Large Capacity Septic Systems - 1 in/near IR, many in RR	Nitrate, pathogens, other contaminants	Leakage of poorly installed or maintained systems	**High Hazard – for the USFS system only. Not evaluated for other systems in RR.**	Shallow aquifer thickness	**High Susceptibility**	Local promotion of advanced septic systems, public education, possible development of community septic systems for upgradient areas
Cropped Ag Land – in the IR	Nitrate, SOCs	Over application or spills of pesticides or fertilizers	**Moderate Hazard – for non irrigated pasture / hay and small grains**	Shallow aquifer thickness, non-irrigation of crops, much of ag land is down gradient from wells	**Low Susceptibility**	Ongoing groundwater monitoring for ag-related contaminants, promotion of BMPs and good cropping practices, coordination with farmers to promote awareness and cooperation with PWS operators
Septic Density – in the IR	Nitrate, pathogens, other contaminants	Leakage of poorly installed or maintained systems	**Low Hazard – very few are in IR**	Shallow aquifer thickness, very low number of these systems	**Very Low Susceptibility**	Ensure that no septic systems are installed inside of the IR
Septic Density - localized higher densities in the RR upgradient	Nitrate, pathogens, other contaminants	Leakage of poorly installed or maintained systems	**Not evaluated. Some areas are upgradient, but not in IR**			Local promotion of advanced septic systems, public education, possible development of community septic system for upgradient areas
Highways and other roadways - in RR	VOCs, petroleum hydrocarbons, SOCs, other	Wrecks and large spills that can reach streams or rivers	**Not evaluated. These are outside of IR**			Emergency planning, training of local emergency response personnel
MDT Maintenance Facilities	VOCs, SOCs, metals, other contaminants	Accidental releases or improper handling or disposal of hazardous materials	**Not evaluated. These are outside of IR**			Evaluation of soil and groundwater contaminant migration from these sites, BMPs, promotion of dry shops, promotion of advanced septic systems
USTs and/or LUSTs	VOCs, petroleum hydrocarbons	Leaks and spills that can reach groundwater	**Not evaluated. These are outside of IR**			Emergency planning, training of local emergency response personnel, groundwater monitoring, spill prevention, BMPs

Notes on Susceptibility Determination table:

- The key to the non-evaluation for most of these significant potential contaminant sources is that they are outside of the Inventory Region boundary and thus outside of the scope of this evaluation. That does not mean that the MDT Maintenance Facility or the USFS large capacity septic system do not pose any potential threat to the water quality in the deep aquifer.

- It is assumed that the hay / pasture land is not irrigated. The hazard for this potential contaminant source will be much greater if the crops/pastures receive a great deal of irrigation.
- BMPs are Best Management Practices
- Potential contaminant sources in/around the Recharge Region, especially within communities situated in the region will be addressed in different SWDARs that focus on that area.

Cropped Agricultural Land

In cases where more than 50% of the Inventory Region land uses are associated with agriculture (such as pasture, hay, and small grain production) the hazard is typically considered high. For this susceptibility determination, this author assumed that the area just north of Bigfork does not need extensive irrigation to produce multiple cuttings of hay, good pasture, or successful small grain crops. If the agricultural land is irrigated, the hazard associated with this land use would be considered higher than if it was not irrigated, but the land use coverage does not differentiate these features. This author began this assessment with the assumption that the pasture, hay, and small grain production on this land posed somewhat less of a threat and assigned the hazard as moderate. Multiple barriers are thought to be in place, which suggests that the PWS has a low susceptibility to contamination from this land use. Suggested management to reduce the impacts to the PWS from the surrounding agricultural land would include the promotion of best management practices (BMPs), good cropping practices, and ongoing good coordination and communication between the farmer(s) and the PWS operators. That communication will go a long way toward the protection of the PWS water quality over time.

Summary of Susceptibility

The Bigfork County Water & Sewer District public water supply uses 2 wells located about 3 miles north of town. These wells are installed into deep alluvium or glacial outwash materials that make up a laterally extensive confined aquifer. The recharge area for this aquifer is along the margins of the Kalispell valley, so it is the interpretation of this author that the recharge area for the portion of the aquifer beneath the Bigfork Co. W&S District production wells is the area along the range front of the Swan Mountains. This is located to the east and northeast of Bigfork along the Swan Range. The groundwater beneath the area of the wells is believed to flow approximately northwest to west and appears to discharge into the shallow alluvium beneath the Flathead River. For the purposes of this delineation and assessment, this SWDAR's Recharge Region boundaries were established as seen on Figure 6. The Recharge Region extends north to the area of Columbia Heights and includes most of the land between the Swan Range and the Flathead River. No significant potential (or actual) contaminant sources were identified in this area that could affect water quality at the PWS over a period of years. The Inventory Region that was delineated for the Bigfork Co. W&S Distr. wells is a 1,000-foot radius circle around the wellheads. This relatively small Inventory Region does not include many potential contaminant sources. There are a couple of significant potential contaminant sources in the Inventory Region, but of greatest significance is a large capacity onsite septic system that appears to be associated with a USFS facility and the large percentage of the Inventory Region that is used for agriculture. The PWS wells appear to have a high susceptibility to contaminants associated with the septic system (nitrate and pathogens) and a low susceptibility to contaminants associated with the agricultural land use (nitrates and SOCs). It should be noted that the author couldn't actually confirm the presence of the USFS office or other facility that signifies the presence of a large capacity septic system. If this septic system is not present in the Inventory Region, the next most significant potential contaminant source is the agricultural land use, for which the PWS wells have a low susceptibility. The Inventory Region and nearby contaminant sources are depicted on Figure 5 and discussed on Table 10. Overall, there appear to be very few nearby threats to the Bigfork Co. W&S District production wells

Waiver Recommendation

This section addresses the PWSs that DEQ has classified as Community Non-Transient, which are Bigfork County Water and Sewer District PWS and the Martin City Water and Sewer District PWS. The authors' recommendation is based upon the determination of susceptibility as described above.

Monitoring Waiver Requirements

The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWSs sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for the organic chemicals to systems that have completed an approved waiver application and review process. All PWSs in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), and polychlorinated biphenyls are excluded from monitoring requirements by statewide

waivers.

Use Waivers

A Use Waiver can be allowed if through a vulnerability assessment, it is determined that specific organic chemicals were not used, manufactured, or stored in the area of a water source (or source area). If certain organic chemicals have been used, or if the use is unknown, the system would be determined to be vulnerable to organic chemical contamination and ineligible for a Use Waiver for those particular contaminants.

Susceptibility Waivers

If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. Susceptibility is based on prior analytical or vulnerability assessment results, environmental persistence, and transport of the contaminants, natural protection of the source, wellhead protection program efforts, and the level of susceptibility indicators (such as nitrate and coliform bacteria). The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWSs developed in unconfined aquifers should use a minimum fixed radius of 1.0 miles as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of 1.0 miles as an area of investigation for the use of organic chemicals. Shallow groundwater sources under the direct influence of surface water (GWUDISW) should use the same area of investigation as surface water systems; that is, the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the point of diversion. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation.

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include will logs, pump test data, or water quality monitoring data from surrounding public water systems; delineation of zones of influence and contribution to a well; Time-of-Travel or attenuation studies; vulnerability mapping; and the use of computerized groundwater flow and transport models. Review of an organic chemical monitoring waiver application will be conducted by DEQ’s PWS Section and DEQ’s Source Water Protection Program. Other state agencies may be asked for assistance.

Susceptibility Waiver for Confined Aquifers

Confined groundwater is isolated from overlying material by relatively impermeable geologic formations. A confined aquifer is subject to pressures higher than atmospheric pressure that would exist at the top of the aquifer if the aquifer were not geologically confined. A well that is drilled through the impervious layer into a confined aquifer will enable the water to rise in the borehole to a level that is proportional to the water pressure (hydrostatic head) that exists at the top of a confined aquifer.

The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Susceptibility of an aquifer to contamination will be influenced by the hydrogeologic characteristics of the soil, vadose zone (the unsaturated geologic materials between the ground surface and the aquifer), and confining layers. Important hydrogeologic controls include the thickness of the soil, the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer. These factors will control how readily a contaminant will infiltrate and percolate toward the groundwater.

The Susceptibility Waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. A groundwater source that appears to be confined from surface infiltration in the immediate area of the wellhead may eventually be affected by contaminated groundwater flow from elsewhere in the recharge area. Contaminants could also enter the confined aquifer through improper well construction or abandonment creating a hydraulic connection from the surface to the confined aquifer. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination. Regional conditions that define the confinement of a groundwater source must be demonstrated by the PWS in order to be considered for a confined aquifer Susceptibility Waiver. Confinement of an aquifer can be demonstrated by pump test data (storage coefficient), geologic mapping, and well logs. Site specific information is required to sufficiently represent the recharge area of the aquifer and the zone of contribution to the PWS well. The following information should be provided:

- Abandoned wells in the region (zone of contribution to the well),
- Other wells in the region (zone of contribution to the well),
- Nitrate/Coliform bacteria analytical history of the PWS well,
- Organic chemical analytical history of the PWS well,

The objective of the susceptibility waiver application is to assess the potential of organic chemical migration of contaminants into water that is used as a source. The general procedures make use of a combination of site-specific information pertaining to the location and construction of the water source development, monitoring history of the source, geologic/hydrologic characteristics of the source water, and chemical characteristics of the organic chemicals pertaining to their mobility and persistence in the environment. The area of contribution to the aquifer into which the PWS intake is installed must be defined and plotted. This should describe the subsurface stratigraphy, groundwater and aquifer characteristics, well construction, groundwater flow direction(s), and a listing (and a map) of other wells in the area that draw from the same formations. All surface bodies within a 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well(s) should also be provided as part of the susceptibility waiver application.

Waiver Recommendation of this SWDAR

Based on past monitoring results and the susceptibility assessment of the Bigfork County Water and Sewer District PWS (as it is now configured, using 2 deep aquifer wells located north of town), the PWS appears to be eligible for several monitoring waivers. DEQ records suggest that the PWS currently has a waiver for Phase II Inorganics. Based on the monitoring history for the 2 deep wells, the results of the inventory and the susceptibility assessment of this SWDAR, the geology of the area, the nature of the aquifer from which the wells draw water, the Bigfork Co. W&S District PWS production wells may also be eligible for volatile organics (VOCs) and synthetic organics (SOCs) waivers. For monitoring waiver consideration, the Bigfork County Water and Sewer District PWS should submit a letter to DEQ requesting the specific monitoring waivers. If requested by DEQ, the PWS may also need to provide additional information regarding chemical use on the agricultural land within the Inventory Region.

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GLOSSARY

Acute Health Effect. An adverse health effect in which symptoms develop rapidly.

Alkalinity. The capacity of water to neutralize acids.

Best Management Practices (BMPs). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Coliform Bacteria. Bacteria found in the intestinal tracts of animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.

CAFO. Confined animal feeding operation, which is typically registered by the State of Montana.

Confined Aquifer. A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

Confining Unit. A geologic formation that inhibits the flow of water.

Delineation. A process of mapping source water management areas.

Effective Porosity. The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids can not pass through all openings.

Hardness. Characteristic of water caused by presence of various salts. Hard water may interfere with some industrial processes and prevent soap from lathering.

Hazard. A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through an aquifer.

IOCs. Inorganic Chemicals

Inventory Region. A source water management area that encompasses an area expected to contribute water to a public water supply well within a fixed distance or a specified groundwater time-of-travel distance.

Large Capacity Septic Systems. As defined by the US EPA Underground Injection Control (UIC) Program, these are septic systems that serve more than 20 persons per day for a period greater than 6 months of the year.

Maximum Contaminant Level (MCL). Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act.

Nitrate. An important plant nutrient and type of inorganic fertilizer. In water the major sources of nitrates are septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet.

Pathogens. A bacterial organism or virus typically found in the intestinal tracts of mammals, capable of producing disease.

Point-Source. A stationary location or fixed facility from which pollutants are discharged.

Porosity. The percent of soil, sediment, or rock filled by air, water, or other fluid.

Public Water Supply (PWS). A system that provides piped water for human consumption to at least 15 service connections or regularly serves 25 individuals.

POTW. Publicly Owned Treated Wastewater facility, typically a municipal sewer treatment plant with a wastewater discharge.

SIC Code. The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy.

Source Water Protection Area. For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply.

Susceptibility (of a PWS). The potential for a PWS to draw water contaminated at concentrations that would pose concern. Susceptibility is evaluated at the point immediately preceding treatment or, if no treatment is provided, at the entry point to the distribution system.

Synthetic Organic Compounds (SOC). Man made organic chemical compounds (e.g. pesticides).

Total Dissolved Solids (TDS). The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Total Maximum Daily Load (TMDL). The total pollutant load to a surface water body from point, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

Turbidity. The cloudy appearance of water caused by the presence of suspended matter.

Transmissivity. The ability of an aquifer to transmit water.

Unconfined Aquifer. An aquifer containing water that is not under pressure. The water table is the top surface of an unconfined aquifer.

Volatile Organic Compounds (VOC). Any organic compound which evaporates readily to the atmosphere (e.g. fuels and solvents).

Recharge Region / Watershed. The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

Note: Definitions are taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.

APPENDICES

APPENDIX A

Bigfork County Water and Sewer District - MT0000262
DEQ PWS's Database Output
Water Quality Data

APPENDIX B

Sanitary Surveys
PWS Well Logs
Relevant Correspondence

APPENDIX C

Lithologic Logs, Well Construction, & Background Water Quality Data
Land Use Analysis

APPENDIX D

Concurrence Letter